Operating instructions

Laser Particle Sizer

"analysette 22"
NanoTec / MicroTec / XT

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Fritsch GmbH, Laborgerätebau was certified by the TÜV Zertifizierungsgemeinschaft e.V. on 21.11.2003.

Based on an audit report Fritsch GmbH has been awarded the certificate of compliance to the requirements of DIN EN ISO 9001:2000.

The enclosed conformity declaration specifies the directives fulfilled by the laser particle sizer "analysete 22 NanoTec / MicroTec" in order to carry the CE symbol.

NanoTec model numbers:
22.2000.00, 22.2800.00, 22.850.00, 22.2900.00
MicroTec model numbers:
22.4000.00, 22.4400.00, 22.4500.00, 22.4950.00
MicroTec XT model numbers:
22.4900.00, 22.4940.00, 22.4960.00

applies as of serial number 0001

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1 General / Introduction

1.1 Notes about Operating Instructions

- Fritsch GmbH, Laborgerätebau retains the copyright to these technical documents.
- These operating instructions are not to be reprinted or copied without the express approval of Fritsch GmbH.
- Read the operating instructions carefully.
- All operators must be familiar with the contents of the operating instructions.
- Please follow the notes for your safety.
- The laser particle sizer was designed from the perspective of user safety, however some risks could not be excluded. Follow the advice in these instructions to avoid risks to users.
- The symbols in the right hand margin highlight the risks described in the text.
  Some symbols may also be found on the device and warn against possible hazards existing there. Warning symbols are surrounded by a triangle.
- These operating instructions do not constitute a complete technical description. They describe only the details required for safe operation and maintenance for usage under normal conditions.

1.2 Symbols Used

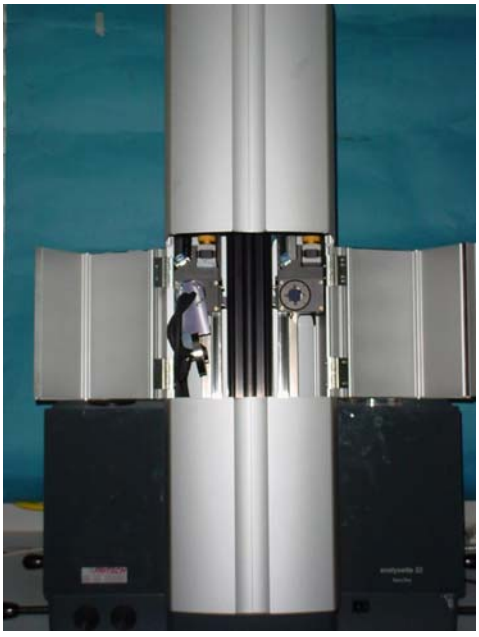
Attention! Warning against danger spot Observe operating instructions	
Attention! Mains voltage	
Attention! Hazard of explosion	
Attention! Inflammable substances	
Attention! Warning against laser beam	
Wear safety goggles!	
Spraying with water forbidden!	
Warning against hand injury!	

1.3 Brief Description of the Device

The laser particle sizer "analysette 22", model NanoTec and model MicroTec are universally usable devices for determination of particle size distribution in suspensions, emulsions, solids and aerosols. They are primarily used in research and development and in quality and process inspections.
The "analysette 22" NanoTec and MicroTec models utilise the FRITSCH patent on a convergent laser beam for determination of particle size distribution.

1.3.1 Design

The measuring device of NanoTec contains two semi-conductor lasers (wavelength 650 nm, laser power 7mW, laser class IIIb). The measuring device of MicroTec contains one semi-conductor lasers (wavelength 650 nm, laser power 7mW, laser class IIIb). Warning labels for laser radiation are located on the inside of the device.
All optical and electrical components are situated in a vertically aligned aluminium profile. Depending on the feature variant, the dry (left side) or liquid dispersion unit (right side) are located underneath the stainless steel covers. Combination versions contain both the liquid and dry dispersion units.
Depending on the model, the measuring cells for measurement in suspension or for measurement of dry solids with a nozzle arrangement for dispersing the sample and a suction device are installed separately or, in the combination devices, together on separate guide rails. Switching of the measuring cell, and therefore switching of the dispersion type, takes place automatically.
The multi-element detector with 80 individual elements and the associated preamplifier are situated in a protected housing on the top end of the optical bench. The measuring device also contains the drive system for sliding the measuring cell or the nozzle arrangement to the two end positions.



The liquid dispersion unit has an approximately 300 ml stainless steel container to hold the samples, which is designed as an ultra-sound bath. The ultra-sound output is approximately 70 Watts at 36 kHz and can be switched on or off as desired. An optical fill level sensor monitors the liquid level in the ultra-sound bath.
A centrifugal pump with flange connection beneath the ultra-sound bath pumps the suspension through the entire measuring circuit. Due to the high flow rate of the suspension, even larger particles with high density are measured correctly. The centrifugal principle also handles mechanically sensitive samples as gently as possible. The supply and discharge of the suspension and the automatic rinsing and filling are performed automatically by electro-mechanical control valves and ball valves.

Do not use any highly flammable, burnable liquids such as alcohols, ketones, benzines, etc.

Do not allow any liquids to flow into the device.

Parts coming into contact with liquid are made of PA66(Nylon), Viton, Teflon and stainless steel.

1.3.2 Function

Analysis devices for determination of particle size distribution with laser deflection make use of the physical principle of the scattering of electromagnetic waves.
Particles in a parallel laser beam deflect the light at a defined angle that depends on the diameter of the particles. A convergent lens focusses the scattered light in a ring on a sensor mounted in the focal plane of the lens. Undiffracted light always converges at the focal point on the optical axis.
With the help of complex mathematics, the particle size distribution of the particles diffracting the light can be calculated from the intensity distribution of the diffracted light. As a result, one obtains a particle diameter from the laser diffraction that is equivalent to that of a ball with identical diffracted light distribution. Average volume diameters are measured and the resulting particle size distribution is a volume distribution.

1.3.2.1 The Conventional Design of the Parallel Laser Beam

The diffraction image in the focal plane can be mathematically described with the help of Fourier optics. The measurement principle is based on the unique property of a convergent lens of performing a two-dimensional Fourier transformation on the incoming field. For this reason, the convergent lens situated in the parallel laser beam is also called a Fourier transformation lens.

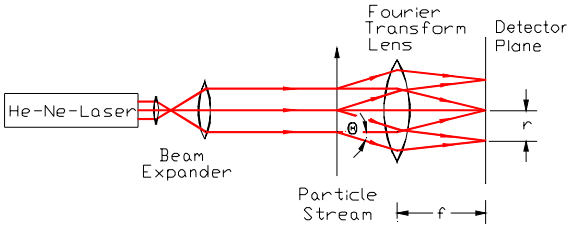
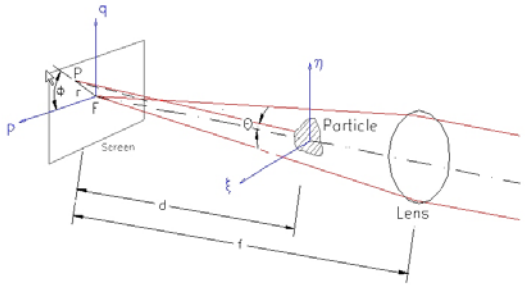


Fig. 1a

The local frequencies of the Fourier components are directly proportional to the focal width of the convergent lens. Changing the measuring range therefore always requires changing the lens, involving reconfiguration of the device. Many manufacturers have therefore adopted an alternative measurement design in recent years, one that was invented by the FRITSCH company.

1.3.2.2 The "Inverse Fourier Design" Convergent Laser Beam

The "analysette 22" offers an alternative optical design that is both state-of-the-art and impressively simple.
The design, which was included in ISO 13320-1 under the term "Inverse Fourier Optics", has long been known as a part of Fourier optics. However, the advantages for particle size distribution measurement were first recognised, utilised and patented by FRITSCH.



The sample is placed within a convergent laser beam. The distance between the measuring cell and the detector is equivalent to the focal length of the convergent lens in conventional applications; one obtains the same diffraction image as with a conventional design without the disadvantages of reconfiguration in order to change the measuring range: the measuring range can be changed by simply moving the measuring cell as with a zoom lens. The user has full control over the local frequencies of the Fourier optics.

- Large distance between measuring cell and detector (TELE)
  → Measuring of coarse particles
- Small distance between measuring cell and detector (MACRO)
  → Measuring of small particles down to the submicron range

The laser particle sizer "analysette 22" is the only instrument with which the measuring cell is moved along the optical axis to adjust the measuring range without the need to change the lens. The sample is therefore always measured with the greatest dynamic and optimal conditions.

1.3.2.3 Resolution

The inverse Fourier optics also allow measurement of a particle size distribution with extremely high resolution. With the fully automatic, computer-controlled positioning of the measuring cell within the convergent beam, a super matrix of up to 520 measurement channels can be created for calculations using the models NanoTec, MicroTec and MicroTec XT. The total measuring range is available without limitation.

1.3.2.4 Fraunhofer / Mie Theory

The energy distribution measured in radially positioned sensor elements is evaluated and used to calculate the particle size distribution. In the "analysette 22", this calculation can be performed according to either the Fraunhofer or the Mie theory.

The Fraunhofer theory, named after German physicist Josef von Fraunhofer and based on diffraction at the particle edges, applies only to fully opaque particles and small diffraction angle.

For particle sizes in the range of the wavelength and below, the Fraunhofer assumption of a constant extinction coefficient
no longer applies. To account for the optical particle properties, the "analysette 22" makes use of the Mie theory, named after German physicist Gustav Mie. It describes the radiation in and around a homogenous, spherical particle in a homogenous, non-absorbing medium for all spatial dimensions. The particles can be transparent or completely opaque.

The Mie theory states that light diffraction is a resonance phenomenon. If a light beam with a specific wavelength encounters a particle, the particle performs electromagnetic oscillations in the same frequency as the stimulating light - regardless of the relationship of the light wavelength to the particle diameter and the refractive index of the particles and medium. The particle is tuned to the reception of specific wavelengths and reemits the energy like a relay station within a defined spatial angle distribution. According to the Mie theory, multiple oscillation states of varying probabilities are possible and there exists a relationship between the optically effective cross section and particle size, light wavelength and the refractive index of the particles and medium.

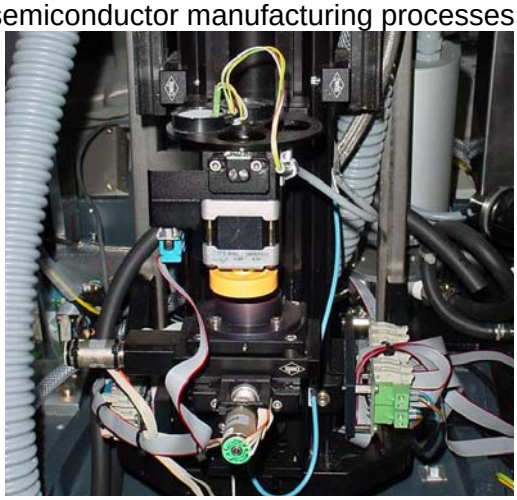
In order to apply the Mie theory, the refractive index and absorption coefficient of the sample and the medium must therefore be known. The software of the "analysette 22" contains these constants for many materials within its database. During measurement, an appropriate diffraction matrix is selected or calculated within seconds upon entry of new constants.

1.3.2.5 Measuring in the Nanometre Range

As the particle size decreases, the diffracted light contains less and less information. At the same time, the diffraction angles become very large and the intensity of the diffracted light decreases significantly. For this reason, more elaborate instrument technology is required for the nano range:

1.3.2.5.1 Forward Diffraction

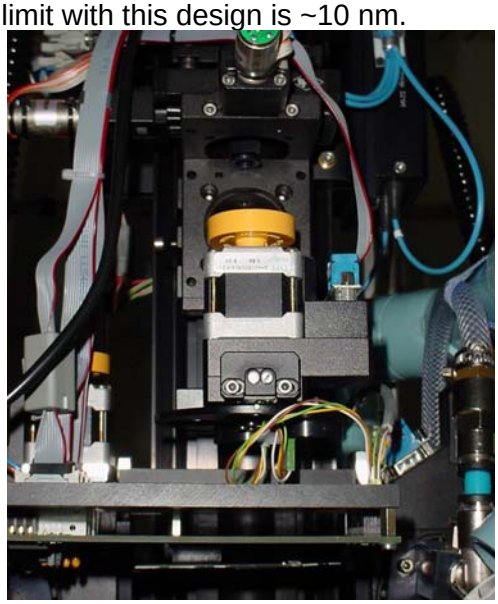
The light diffracted in the measuring cell is diffracted in a forward direction and captured by the light-sensitive elements of the diffracted light detector. The detector contains a micro-hole in its centre, through which the laser light encounters a photodiode to determine the total absorption. Light-sensitive elements are arranged concentrically around this micro-hole. These have increasingly large surfaces in the outer area to compensate for the small diffraction angle of smaller particles. In the inner region of the detector, the elements are very small so that even the diffracted light of large particles can be measured with high resolution. The separation of the individual elements from each other is performed using state-of-the-art semiconductor manufacturing processes.



The diffracted light cannot leave the measuring cell at arbitrarily large angles because total reflection occurs at a specific angle upon transition from an optically more dense to less dense medium. The optical measuring cell glasses of the "analysette 22" are therefore given prism-shaped wide-angle surfaces from which diffracted light can escape at a large angle. This light is measured on the detector by special wide-angle elements. In the forward direction (lower measuring limit ~0.1 µm), a diffraction angle range to approximately 60° is covered with this design.

1.3.2.5.2 Backward Diffraction

To capture the diffracted light of nanometre particles, a significantly larger angle range must be covered. To accomplish this, the "analysette 22" NanoTec uses a backward laser that passes through the same micro-hole in the detector and generates light diffraction in the measuring cell that is then detected by the detector as backward diffraction in an angle range from 60 – 180°.
In addition, the optimised geometry of the detector makes it possible to capture and evaluate the various diffractive effects of nano particles parallel and perpendicular to the polarisation direction of the laser. The lower measuring limit with this design is ~10 nm.



1.3.3 NanoTec / MicroTec Device Description

The NanoTec version is a device combination offering maximum user comfort. The "analysette 22" NanoTec offers everything that a user of modern laser particle sizers expects. High quality optical, mechanical and electronic components combined with modern, flexible software for calculation of the Mie components, the particle size distribution and the resulting parameters guarantee a state-of-the-art analysis instrument. The measuring range is 0.01 to 1000 µm.
The "analysette 22" MicroTec is the measuring instrument for samples in the micron and submicron range. The reduced optical bench allows a very compact and inexpensive design. The MicroTec is the "little" brother of the NanoTec. All hardware and software components are identical with those of the "analysette 22" NanoTec except for the nano expansion. The measuring range is from 0.1 to 600 µm (MIcroTec XT: 0.1 to 2000µm).

As a new feature world-wide, Fritsch offers optional software for shape recognition for the models "analysette 22" NanoTec and "analysette 22" MicroTec.

The dispersing units for measuring in suspensions or of dry solids contain independent processor controls for all functions of sample preparation and feeding. All of their functions can be accessed on the screen using the mouse or keyboard. If you wish, the computer and processor controls work together so that an individually programmed measurement cycle consisting of

- background measurement,
- sample feeding,
- measurement (single or multiple measurement),
- documentation of the results and
- cleaning

is executed fully automatically, e.g. as a routine measurement that can be repeated at the push of a button.
The small dispersing unit is available as a special accessory for preparation of small sample quantities in suspension. With this accessory, you can perform a complete measurement with a small quantity of liquid (approx. 100 ml).
Between the smallest measuring range from 0.1 µm to approx. 53 µm (measuring cell at the smallest possible distance from the sensor) and the largest measuring range between 7 µm and 1000 µm (largest distance between measuring cell and sensor), you can freely select any intermediate range.
The optical bench is constructed of high quality components in a vertical design to save space. Two independent guides for liquid and dry measurements allow fully automatic changing of the dispersing unit within seconds.
The fibre-coupled, robust 7 mW double laser diodes with polarisation-preserving fibre, good temperature stability, high beam quality and long service life radiate in the visible range. A newly developed diffracted light detector on a ceramic base "made in Germany" according to state-of-the-art manufacturing methods offers the best mechanical and thermal stability.

With the expansion for measurement of backward diffracted light, the "analysette 22" NanoTec covers a diffracted angle range from 0° to approx. 180°. It has a double laser diode for diffracted light measurements in the forward and backward directions. To expand the measurement in the nanometre range, the forward laser is switched off and a laser in the reverse direction is activated. This generates light diffraction in the measuring cell that can be captured by the detector as polarisation-selective backward diffraction in the angle range 60 – 180°. The extinction of the backward laser is captured by a photodiode swivelled to a position in front of the forward laser. The "nano" option can be activated in connection with the module for liquid dispersion. For the cell distance of 20 mm, this expands the measuring range of the device down to 10 nm.
You can make use of the full scope of the extremely large measuring range from 0.01 µm to 1000 µm in a single measurement process through controlled coupling of up to 10 individual measurements.
Your wish for a higher resolution in the measurement and calculation of the particle size distribution can be satisified for every multiple measurement by simply inputing the desired number of measurement channels yourself.
After specifying an upper and lower limit, the measurement is distributed among up to ten adjacent measurement areas - the sample is introduced only once before the start of the test.
The result of a measurement performed in this way is characterised by a resolution in up to 570 measurement channels. In this way, wide and highly inhomogeneous samples distributed over the entire measuring range can be measured precisely. The high resolution displays fine details that remain hidden to other measurement methods.
This extreme resolution is particularly interesting in the finest particle range: during multiple measurement within narrow limits, between 0.01 µm and 60 µm, the sample can be measured, for instance, in 155 true measurement channels (or more) and calculated.

1.3.3.1 Liquid Dispersing Unit

The liquid dispersing module offers fully automatic pumping of the suspension. Through the use of a motor-driven 4/2-way valve, the pumping takes place without dead space. With the integrated ultra-sound bath (approx. 500 ml volume, 50 Watts output), even difficult to disperse samples can be measured without additional instrument work. The digital ultra-sound generator keeps the specified output optimal and constant.
The powerful centrifugal pump with 100 Watt output also pumps particles with higher specific gravity and is suitable for long-term operation. The entire liquid volume can be completely pumped once within three seconds with the powerful pump. This makes the measurement independent of inhomogeneities in the sample. The pump rotation speed and ultra-sound output can be adapted to the properties of the sample.
All parts in contact with the liquid are of stainless steel, Viton and PA60.
All functions can be controlled by computer.

1.3.3.2 Dry Dispersing Unit

The dispersing module for dry samples prepares agglomerates using mechanical and pneumatic forces. The dosed sample is supplied by a new amplitude-controlled vibration dosing channel. The dispersing takes place in a two-phase annular gap nozzle through air fins with aerodynamic wave formation at the nozzle outlet and high flow speed in the nozzle channel.
To operate the dry dispersing unit, a connection for oil-, water- and particle-free compressed air with a pressure of at least 5 bar and a flow rate of at least 8 m³/h is required.
The fully automatic measuring sequences can be freely programmed and saved. The entire functional process is controlled by an integrated microprocessor.

1.3.3.3 Combination Unit for Dry and Liquid Dispersing

The combination device contains the module for both liquid and for dry dispersing. The desired dispersing type can be selected with a software command.

1.4 Technical Data

1.4.1 General

Operating Noise

The noise level is 42dB (A).

Voltage

Single-phase alternating voltage 90-230V ± 10%.

1.4.2 "NanoTec" (22.2000.00) MicroTec (22.4000.00) MicroTec XT (22.4900.00)

Current consumption

The maximum current consumption is 0.5 A

Power consumption

The maximum power consumption is 125 W.

Electrical fuses

Electronic fuses in the interior of the device on the switched power supply and beneath the wet connection combination.

Device	Liquid Dispersion	Dry Dispersion
NanoTec	0.01 - 1000 µm	0.1 - 1000 µm
MicroTec	0.1 - 600 µm	0.1 - 600 µm
MicroTec XT	0,1 - 2000 µm	0,1 - 2000 µm

Module	Dry / Liquid	Measuring Time	Sample Quantity/ Liquid Volume	Weight	Dimensions
Combination device for liquid and dry measuring 22.2000.00	dry / liquid	approx. 10 s	dry 5 - 50 cm^3 liquid approx. 0.1 – 2 cm^3 in 500 ml liquid	net 105 kg, gross 140 kg	80 x 65 x 122 cm
Device for liquid measuring 22.2800.00	liquid	approx. 10 s	approx. 0.1 – 2 cm^3 in 500 ml liquid	net 105 kg, gross 140 kg	80 x 65 x 122 cm
Device for dry measuring 22.2900.00	dry	approx. 10 s	5 - 50 cm^3	net 105 kg, gross 140 kg	80 x 65 x 122 cm
Small quantity liquid dispersing unit 22.6750.00 or 22.6700.00	liquid	approx. 10 s	0.1 – 0.5 cm^3 in 100 ml liquid	net 8 kg, gross 10 kg	14 x 14 x 32 cm

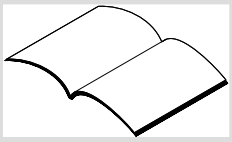
Module	Dry / Liquid	Measuring Time	Sample Quantity / Liquid Volume	Weight	Dimensions
Combination device for liquid and dry measuring 22.4000.00	dry / liquid	approx. 10 s	dry 5 - 50 cm^3 liquid approx. 0.1 – 2 cm^3 in 500 ml liquid	net 90 kg, gross 125 kg	80 x 65 x 94 cm
Device for liquid measuring 22.4400.00	liquid	approx. 10 s	approx. 0.1 – 2 cm^3 in 500 ml liquid	net 75 kg, gross 125 kg	80 x 65 x 94 cm
Device for dry measuring 22.4500.00	dry	approx. 10 s	5 - 50 cm^3	net 76 kg, gross 125 kg	80 x 65 x 94 cm
Small quantity liquid dispersing unit 22.6750.00 or 22.6700.00	liquid	approx. 10 s	0.1 – 0.5 cm^3 in 100 ml liquid	net 8 kg, gross 20 kg	14 x 14 x 32 cm

Module	Dry / Liquid	Measuring Time	Sample Quantity/ Liquid Volume	Weight	Dimensions
Combination device for liquid and dry measuring 22.4900.00	dry / liquid	approx. 10 s	dry 5 - 50 cm^3 liquid approx. 0.1 – 2 cm^3 in 500 ml liquid	net 105 kg, gross 140 kg	80 x 65 x 122 cm
Device for liquid measuring 22.4940.00	liquid	approx. 10 s	approx. 0.1 – 2 cm^3 in 500 ml liquid	net 105 kg, gross 140 kg	80 x 65 x 122 cm
Device for dry measuring 22.4960.00	dry	approx. 10 s	5 - 50 cm^3	net 105 kg, gross 140 kg	80 x 65 x 122 cm

Accessory	NanoTec Liquid	NanoTec Dry	MicroTec/ XT Liquid	MicroTec/ XT Dry
22.6900.00 Small quantity liquid dispersing unit				
22.6750.00 Small quantity liquid dispersing unit	●		●	
22.6700.00 Small quantity liquid dispersing unit		●		●
22.6300.00 Liquid mini vessel				
22.2910.00 Software for particle shape recognition	●		●	

2 Operating Safety

2.1 General Safety Instructions



- Read the operating instructions carefully.
- The device may only be used for the purpose described in Section 1.3 Brief Description of the Device.
- Use only original accessories. Failure to adhere to this may jeopardize the protection of the machine.
- All operators must be familiar with the contents of the operating instructions. For this purpose, always keep the operating instructions within easy reach.
- Do not remove the instruction labels
- Care to prevent accidents must be taken during all work.

- Independent conversions of the device negate the conformity with European directives declared by Fritsch and void the warranty.
- When measuring oxidisable substances, such as metals, organic substances, wood, coal, plastics, etc. the risk of spontaneous combustion (dust explosion) exists if the fine portion exceeds a certain percentage. For this reason, special safety measures (e.g. measurement in suspension) must be taken and the work must be supervised by a specialist.

- In addition, the MAK values of the pertinent safety regulations must be observed, and sufficient ventilation must be ensured or the device must be operated under a hood.
- The device is not designed with explosion protection and is not suitable for measuring explosive, combustable or fire-promoting substances.

- The device may not be used in an electrically conducting, dust-containing or moist environment.
- Do not allow any liquids to flow into the device.
- Do not use any highly flammable, burnable liquids such as alcohols, ketones, benzines, etc.

2.2 Device Safety Instructions

2.2.1 Laser

The measuring unit of the "analysette 22" contains a semi-conductor laser with 7 mW output and a wavelength of 655 nm. The laser of the "analysette 22" NanoTec and MicroTec is therefore classified as Class 3b EN 60825-1/11.2001 and may only be operated in compliance with the corresponding safety instructions of EN 60825 Part 1 and 2 with regard to the laser emitter in the purview of the safety regulations of the German Trade Supervision. The user must familiarise himself with the hazards involved with laser emitters before using the device.
Warning labels regarding the laser emissions are located on the inner doors of the device.

Caution!

- Never look into the laser beam.
- Never place reflective objects within the laser beam.
- Wear appropriate safety goggles during maintenance or calibration work on the open laser emitter. (< 10 mW, 655 nm).
- The device equipped with a laser emitter may only be operated by authorised personnel.
- The user of the device must familiarise himself with the hazards involved with laser emitters before using it.
- Do not remove information and warning signs.

Laser devices of laser classes 3B and 4 are hazardous to the human eye; even an exposure time of 0.25 s is sufficient to cause permanent damage to the retina. For this reason, any person operating the device with opened doors must wear suitable safety goggles. The safety goggles must be suitable for the wavelengths of the laser used; for example, safety goggles that protect against a green laser fail against a red laser. The wavelength of the built-in laser is 655 nm.
For laser devices of laser safety class 3B or 4, laser safety officers must be appointed in accordance with GUV 2.20.

2.2.2 Ultra-sound Bath

The ultra-sound bath built into the liquid dispersing unit has an output of 70 Watts. PZT ultra-sound oscillators fastened to the oscillating trough convert electrical energy into mechanical vibrations. Fritsch ultra-sound baths cause the liquid to vibrate at 36 kHz. This causes the formation of tiny vacuum bubbles that implode (cavitation). This cavitation principle destroys agglomerations.
Liquids contain dissolved gasses (e.g. oxygen). Freshly added liquids or liquids remaining in the oscillating trough for longer periods of time should be exposed to ultra-sound for approx. 5 to 15 minutes before use. During the degassing period, the cavitation noise alters, loud degassing noises disappear at the end of the degassing process, the device operates noticeably more quietly. A lower noise level does not mean any subsiding in the ultra-sound output, only the end of the degassing process.

Caution!

- Do not operate the ultra-sound bath without liquids.
- Do not use any flammable liquids (e.g. benzine, solvents) and no chemicals that contain or give off chloride ions (some disinfectants, household cleaners and dishwishing soaps) for ultra-sound cleaning in the stainless steel trough.
- Do not use aggressive cleaning liquids (e.g. acids, salt solutions).
- Do not reach into the cleaning fluid during ultra-sound cleaning.
- The cleaning fluid heats up during longer periods of operation; check the temperature.

2.2.3 Moving the Measuring Cells

Do not operate the device with open doors. Due to the high torque of the motor for moving the measuring cell, severe pinching or injuries can occur if the measuring cell is moved while the doors are open.

Always close both doors before initiating "Start Measurement".

2.3 Operators

- The device may only be operated by authorised persons and maintained and repaired by trained experts.
- Persons under the influence of health impairments, medications, drugs, alcohol or excess fatigue may not operate the device.

2.4 Safety Equipment

Safety equipment such as coverings must be used as instructed and may not be disabled or removed.

2.4.1 Laser Emissions

The laser emissions are not directly accessible because the laser is always blocked off by mechanical shutters after a properly completed measurement. Sudden, uncontrolled opening of the doors by the user also does not lead to a hazardous state because built-in electronics together with the light-sensitive silicon detector immediately detect an increase in the residual light, the measurement is halted and the laser is blocked by the mechanical shutters. This state remains in effect until the doors are closed. Then a new measurement cycle must be started with "Start Measurement".
For this reason, the "analysette 22" NanoTec and MicroTec are classified as laser safety class 1.

2.4.2 Pinching Danger

Sudden, uncontrolled opening of the doors by the user does not lead to a hazardous state because the built-in electronics together with the light-sensitive silicon detector detect an increase in the residual light and any movement by the measuring cell is immediately halted. This state remains in effect until the doors are closed. Then a new measurement cycle must be started with "Start Measurement".

2.5 Danger Points

Pinching danger at the cell holder when moving the measuring cell. Do not operate the device with open doors.
Laser emitter with 7 mW output, laser class 3b, do not look into the beam. Only operate the device in an open state while wearing safety goggles.

2.6 Electrical Safety

Attention:

Connect the measuring device to a power supply line protected with a residual current circuit breaker.

2.6.1 General

The power switch disconnects the machine from the supply at both poles.

2.6.2 Overload Protection

The power supply protection provides overload protection.

3 Installation

3.1 Transport

Transport over larger distances only in a transport box.

3.2 Unpacking

Compare your order with the delivery! In the event of incomplete delivery and/or transport damages, inform the shipper and FRITSCH GmbH (within 24 hours). Later complaints can no longer be accepted.
Only open the boxes while the arrows point upward! Remove the transport packaging as shown in the following pictures.

Unscrew the carry grips from the base plate and insert the grips into the fixtures in the accessory case provided for this. Close the screw holes in the base plate with the closing plugs from the accessory case.

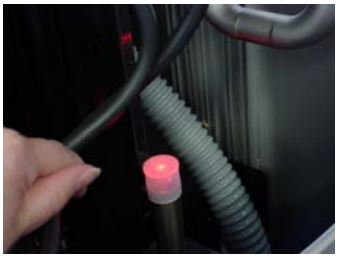
3.3 Setup

- Place the device indoors on a flat, stabile surface. It is not necessary to fasten the device in place.
- Please avoid intense heat (sunlight, heaters, etc.), dusty environments and their effects on the interior of the measuring device as well as extreme humidity (>85%).
- During operation of the device, the ambient temperature may not exceed 35°C or fall below 10°C. Storage between 1°C and 40°C is possible. If it is expected that the temperature will fall below the permissible temperature range (e.g. for a planned transport), it is essential that the entire suspension circuit (dispersion unit, hoses and measuring cell in the measuring device) first be rinsed thoroughly with ethanol and the liquid then completely removed.
- The device may not be switched on while cooled below the permissible temperature.
- After the device has been cooled to temperatures below 10°C, you must wait for the device to warm to ambient temperature before switching it on; condensation in the device can lead to disruptions and damage.

- You will be able to see characters and graphics on the screen more easily if you select a setup location such that sunlight or artificial light do not fall directly on the image tubes. Sometimes simply turning the monitor "out of the light" will help, partial shadow increases the contrast and helps to prevent eye fatigue.
- Easy accessibility should be ensured during setup so the device can be operated without difficulty. When opening the measuring device, you must be able to reach the measuring cell easily.
- The setup location must be protected against water. If there exists the risk that a water layer could form on the setup surface in the event of an error, you must select another setup location. If no other location is available, the entire device must be elevated (use riser blocks).

3.4 Transport safety device

To avoid damanges of the laser diode during the transport, it is secured by a protecting cap (**MicroTec model**).
Please remove this before the first measurement.



3.5 Accessory Case

The accessory case contains

- Agents and tools for cleaning the optical glass elements (cleaning liquid, cleaning cloths, compressed air, etc.)
- Replacement screws and hose clamps for the measuring cell
- A storage tool for the front flange of the measuring cell with glass
- Tool for assembly and maintenance
- A CD-ROM with software
- A micro-fibre cleaning cloth for metal and glass surfaces
- Internal particle size standard F500, F70
- Cell storage tool
- Closing plugs and carry grips

3.6 Electrical Connection

Connect the measuring device, the computer with monitor and the printer to a power strip each with separate power cables. The enclosed power cable is intended for the measuring device. It is a special design with electronic filter that was selected to ensure error-free operation:

Attention:

Connect the measuring device to a power supply line protected with a residual current circuit breaker.

3.6.1 Electrical Fuses

The device has two device fuses beneath the power connection assembly.
The internally required, stabilised direct current of 24 V is provided by an integrated switched power supply with internal electronic short circuit and surge protection.

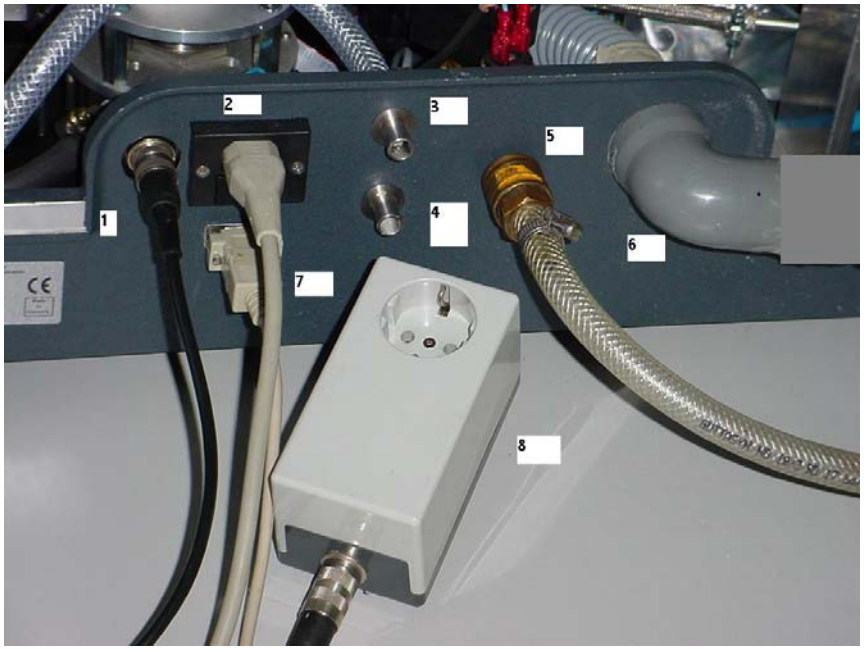
3.6.2 Stability of the Power Supply

Devices with electronic components demand stabile supply voltages (+/- 5% deviation). For weak power networks or networks not safe against errors (voltage peaks due to inductive load changes or switched-mode power supplies), we recommend connecting a voltage stabiliser and filters between the power supply and device (order no. 20.600.00).

3.6.3 Adapting to the Power Network

Manual switching of the voltage ranges on the device is not necessary because the device can be operated with 90 – 230 V. The switching is performed automatically.

3.7 Connections



1. Connection control box (8) for vacuum (dry dispersing)
2. Main power supply
3. Suspension liquid supply (water connection at least 2 bar)
4. Suspension liquid discharge
5. Compressed air supply (7m³/h, at least 5bar) (dry dispersing)
6. Connection for vacuum (dry dispersing)
7. RS232 connection to the computer
8. Control box for vacuum (dry dispersing)

3.8 Preparing the Computer

See the software operating manual.

3.9 Data Connections

Connect the 9-pin connector on the rear of the device to the Com1 or Com2 port of your computer with the included RS232 cable.
After checking all connections, the plug of the power strip may be connected to the power network as the final step.

3.10 Switching on the Device

Switch the device on with the main power switch on the front lower right of the device. The internal control then performs an initialisation routine. Any measuring cells positioned within the beam path of the laser are moved to the park position and the entire measuring cell is positioned at its reference point. All filter wheels for transmitting or blocking the laser beams are moved to the reference point.
The initialisation routine may last a few seconds.

3.11 Checking the Communication

After you have established the serial connection between the measuring device and the computer, you must check the communication.
To do this, open the associated program "analysette 22 for Windows" and select the item "Set System Configuration" in the "Configuration" menu. In the dialog "Set System Configuration...", select your version of the analysette 22. In the dialog that appears next to the lower right, select the RS232 port of your computer to which you have connected the cable to the measuring device.
If you do not receive any communication in the following steps, this is usually the result of a missing or non-functional RS232 port on your computer. In this case, always check the hardware of your computer.

3.12 Function Check

Select the version of your "NanoTec / MicroTec", and the liquid dispersing for combination devices.
Enter "Measuring Range Setting" and select a cell distance of 190 mm.
Enter the "Beam Adjustment". You will not immediately see signals from the detector; you will see signals only after you have selected "Manual Adjustment" and clicked on one of the arrows. Then one data record is sent from the measuring device to the computer. Check whether the beam adjustment is accurate (see here the operating manual).
Select only "Background Measurement" as the measurement process.
Press "Start Measurement".
The measuring cell must now move to a distance of 190 mm and you must see the signals of the background measurement on the screen.
Now perform a measurement with the Fritsch internal standard sample.
Instructions for this can be found in the Fritsch reference manual.

4 Liquid Dispersing Unit

4.1 Installing Hose Connections

The liquid dispersing unit has two pipe connectors in the rear for hoses with 18 mm inner diameter. The 18 mm pipe connector with the designation "Out" (lower connection) serves to release used measuring and rinsing fluid through the discharge valve. Lay the hoses without kinks.
The 18 mm pipe connector with the designation "In" (upper connection) should be connected directly to your building water connection. It serves to fill the measuring apparatus. The device has an internally integrated pressure reducer that is permanently set to 1.5 bar.

In order to ensure that the rinsing process can be completed properly, you must therefore provide at least 2 bar from your water supply.

If you connect the supply connection "In"

- with demineralised, filtered water or
- a liquid storage tank

that supplies a pressure less than 2 bar, more liquid will be discharged than can be supplied. In this case, you must reduce the cross section of the discharge hose (e.g. with hose clamps) until the rinsing process once again functions properly.

Reduction of the discharge hose cross section always leads to a less effective cleaning because the liquid in the ultra-sound bath no longer discharges completely and is therefore only diluted further. This increases the risk of residues in the sample and therefore carry-over.

The hose connections must be connected pressure-tight with hose clamps.
You should check the position of the supply hoses in the device before the first measurement. To do this, move the cell from the top to the bottom position.

Risk of injury:

A risk of injury by pinching exists for the operator while the positioning drive is operating and the door is open.

Movement of the measuring cell is initiated according to the setting of the measuring range: e.g. if the smallest measuring range is selected, the measuring cell moves to the upper stop. When the largest measuring range is set, it moves to the lower end point. Select "Background Measurement" and press "Start Measurement". The measuring cell moves. Instructions for selecting the program and adjusting the settings can be found in the software manual.

4.2 Selection of the Liquids

The measuring liquid in the device (supply and measuring unit) only comes into contact with materials that are largely chemically resistant. Certain organic liquids or saturated inorganic salt solutions may be used briefly without damaging the device.
(The measuring fluid comes into contact with stainless steel, glass, Teflon, Viton (FPM and FKM) and PA60 (Nylon)). The standard connection hoses are made of Viton.
For measurement of samples not compatible with water, an appropriate liquid can be selected from the following list:

- Mono-, di- or tryhydric alcohols (except for methanol), e.g. ethyl alcohol, isopropyl alcohol, glycol or glycerine
- Benzines (petroleum ether, test benzine, kerosine),
- Mineral and organic oils such as petroleum and soy oil, nut oil, olive oil
- Cyclic aromatic compounds / ring hydrocarbons (toluene only briefly - rinse out after the measurement)
- Alkanes
- (Hexane, heptane only briefly - rinse out after the measurement because the connecting hoses will be damaged.)
- Formaldehyde
- Saturated solutions of inorganic salts

Before the planned use of other measuring fluids, the factory must first be consulted.

In principle, we warn against the use of liquids that are explosive, combustible or hazardous to health - they cannot be recommended.

The above summary serves only to indicate the chemical compatibility of the device in relation to liquids.

The measuring device and dispersing units are not designed with explosion protection.

The liquid consumption is significantly reduced through the use of the small quantity dispersing unit.

The following may not be used:

Ketones (acetone, propanone, butanone, cyclohexanone),

Ether, fluorochlorohydrocarbons,

Amines, freon 21-32, methanol, aniline, benzene

Chlorohydrocarbons such as ethanoic acid and their derivitives, undiluted acids and bases.

When using measuring liquids hazardous to health, always follow the applicable safety regulations (MAK values) and place the measuring unit and dispersing units in ventilated safety zones if required.

4.3 Cleaning

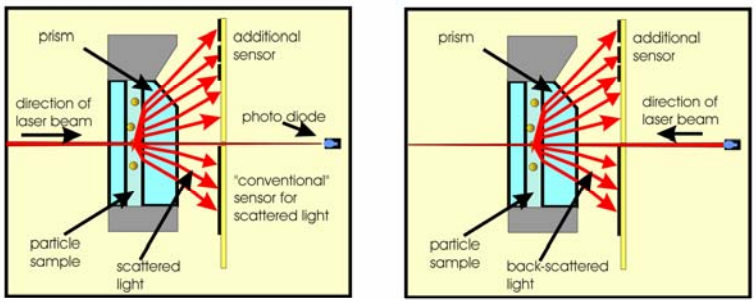
4.3.1 Cleaning the Device

The device can be wiped with a moist cloth or the micro-fibre cloth from the accessory case.

Do not allow any liquids to flow into the device.

4.3.2 Cleaning the Measuring Cell

The measuring cell has angled surfaces on the side facing the detector so that light can leave the measuring cell even with large diffraction angles. The window on this side is firmly attached to the metal of the measuring cell. The opposite window is loosely inserted into a slot in the measuring cell and can be removed for cleaning.



"Normal" measurement using laser 1 Illumination from back side using laser 2

4.3.2.1 Service Position

In the "Setup" program under "NanoTec / MicroTec Control Window", select the item "Service Position". The measuring cell is then moved to the opening area of the doors and the measuring cell is swivelled to the outside so that it is located outside the device. This prevents any liquid used during cleaning from flowing into the device.

4.3.2.2 Preparation

Lay out the following:

- Tool for cell disassembly
- Measuring cell storage tool

Assemble the tool for disassembly of the measuring cell and place the cell storage tool in a handy location.

4.3.2.3 Preparation

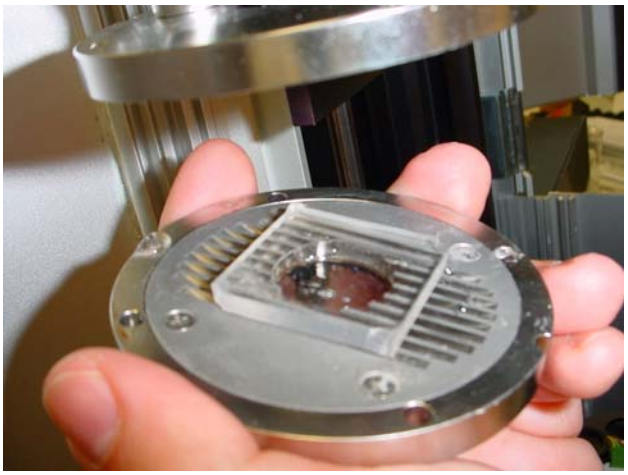
In the "Setup" program under "NanoTec / MicroTec Control Window", select the item "Open 4/2-way valve to discharge". The liquid in the system then drains out.

4.3.2.4 Disassembling the Measuring Cell

Although the measuring circuit should now be completely without liquid, it may be that residual liquid remains in the measuring cell itself. Therefore, you should have a paper towel or something similar ready to directly collect any liquid escaping.
Unscrew the four screws on the underside of the measuring cell. Be careful to hold the bottom parts of the measuring cell and the front measuring cell glass firmly while doing so.

Attention:

After removing the last screw, the top measuring cell glass falls onto the lower part. If the measuring cell is very dirty, it is possible that you must also apply light pressure from above (with paper towel).

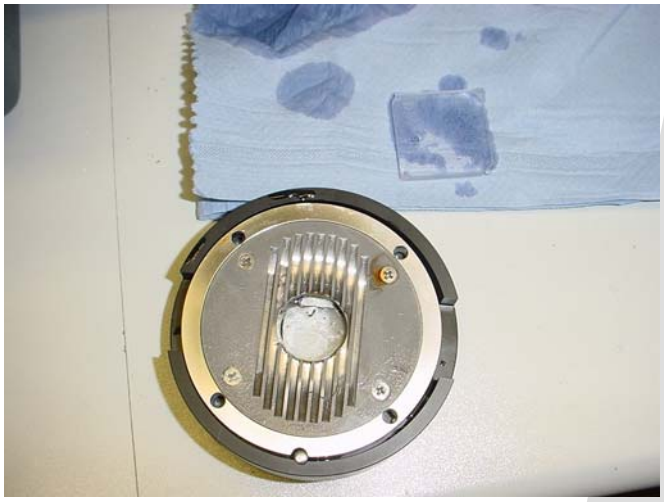


Place the flange on the cell storage tool.

Attention:

NEVER place the lower part of the measuring cell with the glass face down on an unprotected surface. This could scratch the optical glass or destroy the anti-reflex coating. This can make your entire measuring cell unusable.

Place the loose window with the outside down on the optical paper.



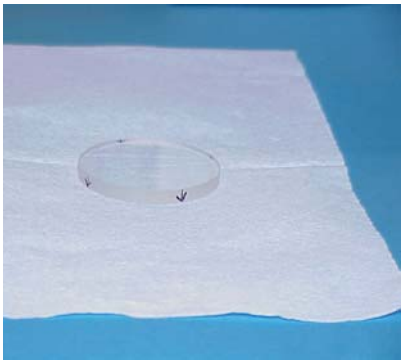
4.3.2.5 Cleaning

It is normally sufficient to rinse the measuring cell with a clear liquid. To remove stubborn residues, you can also add a cleaning agent to the cleaning liquid. Usually a few drops of a surface-active household cleaner (cleanser e.g. Pril™ or liquid soap) is sufficient.
Mechanically adhering contamination can be rinsed out with the addition of approx. 2 g of fine abrasive. (Household abrasive ATA™, VIM™,....).
Oily residues can be rinsed out with a slightly alkaline cleaning agent.
It can be necessary over time to clean the insides of the measuring cells as well. This is necessary if, with the measuring cell all the way to the left (with activated laser beam), you see many small points of light on the insides of hte window that cannot be removed by rinsing multiple times or if the window has become matte.
In the "Setup" program, under "Control NanoTec", select the button "Park Position". The measuring cell is then moved to a distance of approx. 150 mm so that it is located in the area of the door opening. If the measuring cell was swivelled into the laser beam path, it is now swivelled out to a park position.
In the "Setup" program, under "Control NanoTec", select the button "Service Position"; this swivels the measuring cell out of the device and you can perform the necessary steps outside of the device.

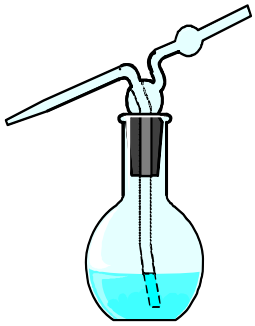
4.3.2.6 Cleaning the Window

4.3.2.6.1 Loose Window

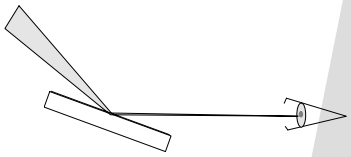
Before disassembling the measuring cell and cleaning the windows, the spacer disk and the seal rings, place a spray bottle with distilled water and the "lens cleaning paper" from the accessory case on a clean work table.
Great care is required for cleaning the windows. The windows may only be touched by hand on their edges.



The following window cleaning method has proven successful:



Rinse the window using the spray bottle of distilled water until no large contamination is visible. Then place the special paper against the inside of the window and moisten it with distilled water and one drop of tenside (Pril) so that the paper adheres to the glass surface.
To "wipe off" the surface, slide the paper off parallel to the surface without pressing the paper against the glass.
You may need to repeat this wiping process on the glass surface with fresh paper until contamination can no longer be seen. Sample residue that adheres very strongly can be "softened" with a tenside (e.g. Pril™) and very carefully wiped a little with the special paper.
Then rinse the window clean with the spray bottle and dab it off carefully onto the dry special paper. You should carefully keep the window covered until it is installed again in the measuring cell.
The spacer disk must be handled carefully! It is manufactured to be plane-parallel with an extremely low tolerance and may not be subjected to any mechanical stresses. A bent spacer disk cannot be used. You can rinse the spacer disk under flowing water. Brush off any adhering particles **very** carefully with a soft brush.
The seal rings can be rinsed under flowing, particle-free (distilled) water and then dried with lint-free, soft paper.
Assembly of the measuring cell is performed in reverse order: insert the loose glass with the **bluish shimmering anti-reflex coating to the outside** (arrows are located on the window edges, see picture, arrow tips pointing to the outside, to the anti-reflex layer)**.**



You can identify the anti-reflex layer by holding a window at an angle to a fluorescent lamp. If you see the inner border of the window shimmer in a bluish colour, the reflex layer is facing up. The coated side is also marked with an arrow on the edge of the glass.
If the inner border appears whitish, the reflex layer is facing down because the light entering into the window does not appear coloured by the anti-reflex layer. Then position the spacer disk such that the sample supply and discharge is not covered - then carefully place the two halves of the measuring cell together. The screws must be tightened carefully in a **cross pattern**.

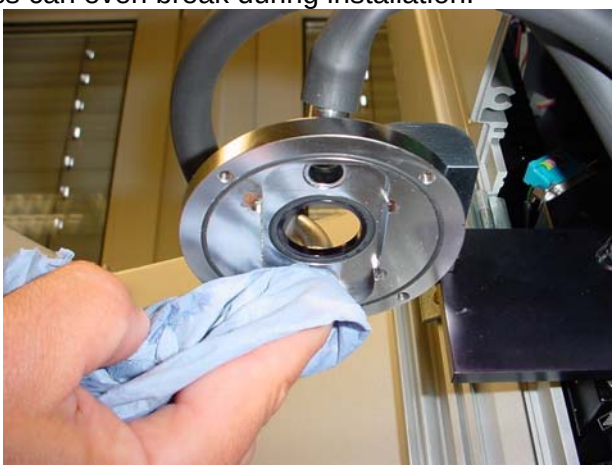
You must take care that you "close" the two halves evenly with the four screws. The spacer disk situated between the two windows holds the windows in an exactly parallel position. Any contamination remaining between the **windows and the spacer disk** must absolutely be removed first. A particle remaining between the glass and the spacer disk can lead to **breaking of a glass** when screwing the cell together! It also prevents the windows from being perfectly parallel.

When moving or sliding the measuring cell to adjust the measuring ranges, the calibration of the laser is disrupted by unparallel windows. (The calibration is no longer valid for the entire adjustment range of the measuring cell due to the prism effect of the unparallel measuring cells.)

4.3.2.6.2 Flange Window

The same applies to the window attached in a fixed position with the metal flange as for the loose window. Handle the optical surfaces very carefully.

Also clean all metal surfaces and seals very well. Adhering grains can lead to the window not being optimally installed and the laser beam is brought out of calibration by moving of the measuring cell. In extreme cases, a glass can even break during installation.



4.3.2.7 Installing the Measuring Cell

After you have cleaned both windows and cell halves, you must install the measuring cell again. Lay the loose glass in the direction of the channels on the flow disk.

The groove in the picture above perfectly matches the groove in the opposite flange of the measuring cell. Take care to ensure correct positioning.

Do NOT tighten any screw all at once! Turn the screws a little tighter in alternation until all screws are tight. If you tighten the screws unevenly, the windows may break.

4.4 Filling the Measuring Cell

4.4.1 Liquid Dispersing Unit

Select the measurement process "Rinse Before Measurement" and press "Start Measurement". The ultra-sound bath then rinses itself and fills itself with clear measuring fluid. The fill level sensor automatically closes the valve.

4.4.2 Filling the Measuring Cell When Using the Small Quantity Dispersing Unit

Emptying and filling of the small quantity dispersing unit is performed manually.
Turn the valve lever to "Drain/Fill". With the supply opened, fresh suspension liquid then flows into the glass container through the connected "In" hose. The liquid level rises while the pump is switched off.

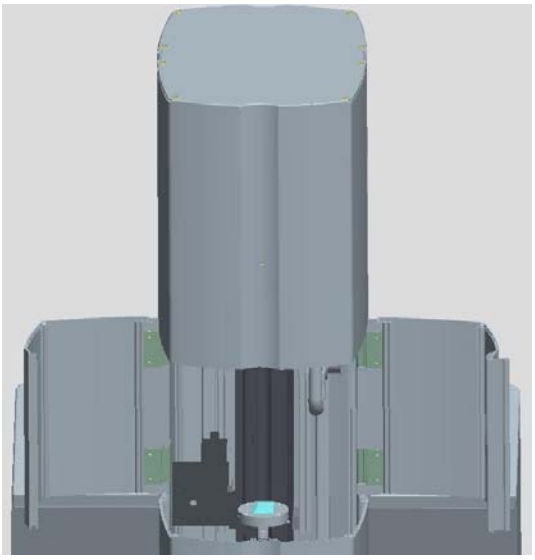
4.5 Setting the Measuring Range for Calibration

The calibration of the laser beam is performed with the measuring cell in a middle position (approx. 200 mm). Inspection of the calibration takes place at the positions 385 mm (MicroTec: 290 mm) and 9 mm.

If you enter "Set Measuring Range", change the measuring cell distance and close the dialog with "OK", the measuring cell does not move immediately but only after you have started a new measuring cycle with "Start Measurement". You can directly halt this with "Stop Measurement".

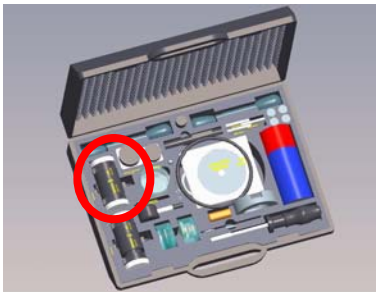
To inspect the calibration at 20 and 385 or 290 mm, simply activate a multiple measurement in Set Measuring Range with 20 mm and 385 or 290 mm. Select "Background Measurement" and press "Start Measurement". The measuring cell is then moved to the respective positions.

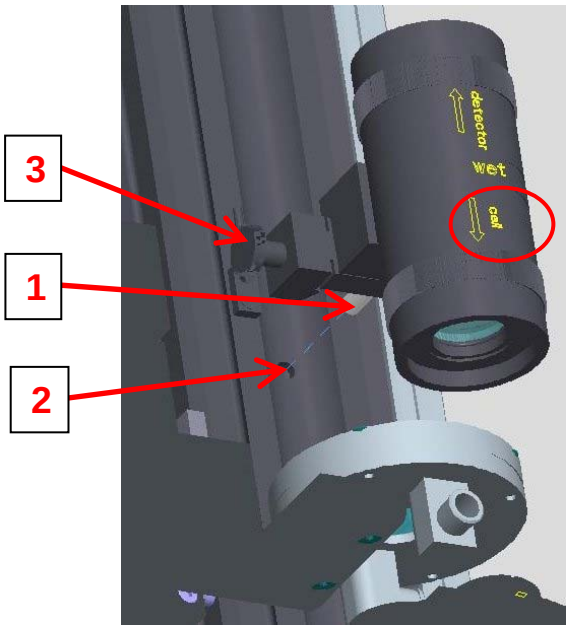
4.6 Mounting instructions Measuring Range Extension Kit “WET”



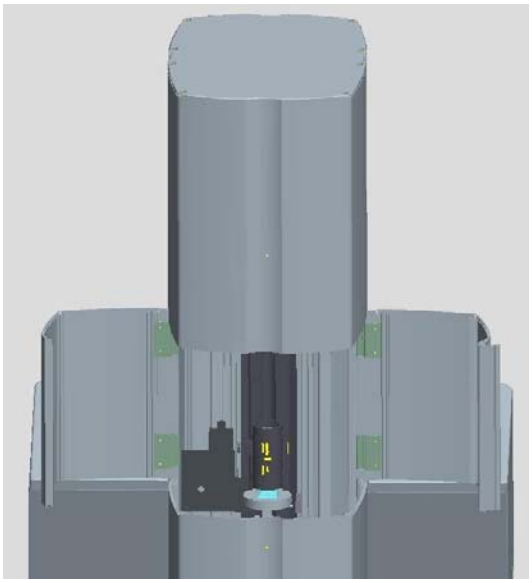
1. Configuration, Set Configuration, NanoTec/MicroTec System, Use Option for extended Measuring Range. Please note the software instructions.

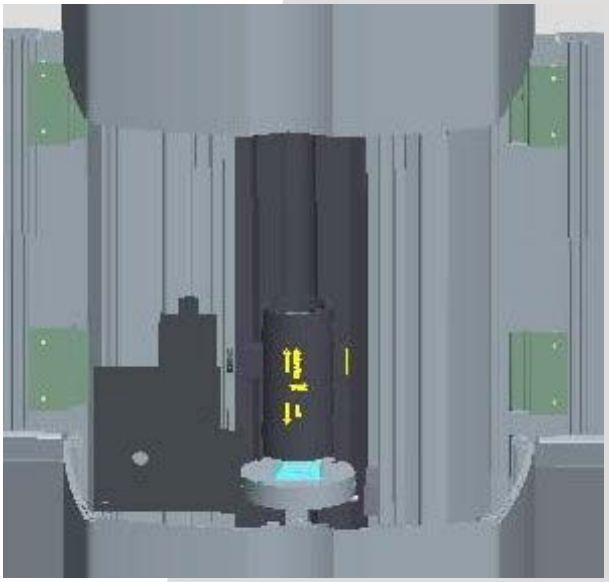
2. Take the Measuring Extension Kit ***“wet”*** from the accessories case and remove lens caps.





3. Introduce the body of the tube with locating pin (1) into the drilling planned for it (2) in the profile of the optical bench. Insert the measuring range extension kit in such a way that the signature ***"cell"*** shows towards the measuring cell. Put the rider on the profile and tighten the knurled thumb screw (3).





4. Ready
5. For the disassembly of the measuring range extension kit proceed in reverse order.

5 Dry Dispersing Unit

5.1 Preparing the Dry Dispersing Unit

5.1.1 Dry Dispersing Nozzle and Measuring Cell

The dry dispersing nozzle with dry measuring cell is mounted on the right guide rail (while facing the device). This measuring cell also swivels automatically into the beam path of the laser. To do this, select the item "Select Dry Dispersing Unit" in the program for the NanoTec / MicroTec. After you have selected the option Background, Adding Sample or Measurement, the dry measuring cell swivels automatically into the beam path after pressing "Start Measurement". If the liquid measuring cell was swivelled in, this is automatically swivelled out first.
The sample hose, a compressed air hose and the hose for suction are already connected to the dry dispersing unit.

5.1.2 Connecting the Measuring Device

The dry dispersing unit has rear connections for all required hoses. Connect your external compressed air supply with the included hose (3 m compressed air hose with compressed air connector).
On the rear side of the device, you will find connectors for all electrical connections. Connect the measuring unit to the main power supply with the included cable.

Attention:

NEVER operate the dry dispersing unit without the vacuum. In this case, the glasses of the measuring cell will become very dirty and may become unusable.

Connect the control box for the vacuum to the dry dispersing unit (round connector).

5.1.3 Compressed Air Technical Data

The compressed air must be oil-free, particle-free and dry. If this is not the case, the measurement results will be inaccurate.

The compressed air supply must be capable of providing an air flow of at least 7 m^3/h (approx. 120 l/min).
We recommend using at least a particle, oil and water filter with a filter effect in the micron range.

5.1.4 Connection to the Computer

Connect the measuring unit with the included 9-pin data cable to an RS232 port of your computer.

5.1.5 Connecting the Vacuum

Connect the control box for the vacuum to the power network and insert the power plug of the vacuum system into the socket of the control box (max. 16A).

Vacuums frequently produce disruptions in the power network. For this reason, it is best to connect the control box to a different power supply than the rest of the equipment (measuring unit, computer, etc.).

The control box of the vacuum can be delivered with an adapter so that the various power plugs of different countries will fit.
Insert the hose of the vacuum into the connection provided for this on the measuring device. The connection has a diameter of 40 mm, appropriate for typical commercial vacuums. Should your vacuum not fit onto this connection, you must obtain an appropriate adapter from your local accessory store.

5.1.5.1 Vacuum Technical Data

The following information represents the minimum guiding values to be fulfilled and may differ depending on the vacuum used. However, the minimum values must be fulfilled.

Power consumption:	max. 1100 Watts
Air flow:	40 l/s
Vacuum:	23kPa
Vacuum power:	270 W
Filter surface:	2400 cm²
Dust bag capacity:	9.0l

5.1.6 Setting the Pressure

A pressure reduction valve with manometer is located on the front side of the measuring device. During the measurement, an electrical valve opens and switches the compressed air to the nozzle.

Use the choke valve to set the pressure according to the material. The optimal working range of the nozzle is between 3 and 4 bar. For sensitive samples, 1 bar may already be sufficient.

Do not set the compressed air to a lower value because the system does not function with lower pressures. A pressure that is too high produces more water in the circuit, which should be avoided. Before setting the pressure, you must pull on the black button on the front of the controller.

5.2 Cleaning the Measuring Cell Windows of the "Dry Dispersing Unit"

Please check the "Beam Alignment" after about every 20 measurements to control the light intensities. If you discover increasing channels in the fine area (in the right section of the window toward "Beam Alignment") with a total level of more than 50%, then the windows should be cleaned.

5.2.1 Service Position

In the "Setup" program under "NanoTec / MicroTec Control Window", select the item "Service Position". The measuring cell is then moved to the opening area of the doors and the measuring cell is swivelled to the outside so that it is located outside the device. This prevents any liquid used during cleaning from flowing into the device.

5.2.2 Disassembly of the Measuring Cell

The cell windows consist of saphire glass. Perform the cleaning carefully, although the surface normally cannot be scratched. Because the windows are treated on their outside surfaces with an anti-reflex coating, you must still handle them very carefully. A scratch in the anti-reflex coating has the same effect as a scratch in glass.

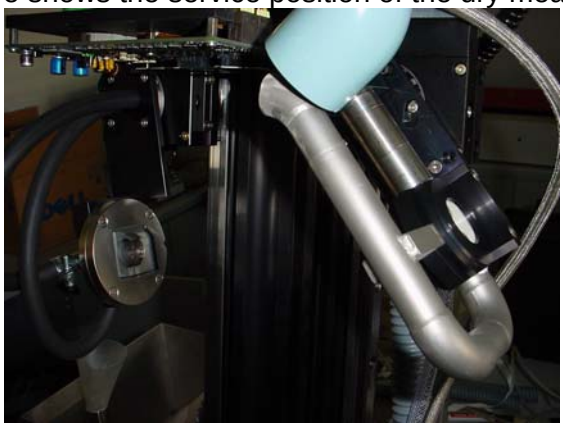
Attention:

The anti-reflex coating is very soft, even cleaning with normal paper tissues can damage the windows.

Always use lens cleaning paper from the accessories case.

Take the required tool from the accessory case and lay it ready.

The next picture shows the service position of the dry measuring cell.



Remove the two screws on the upper cover plate of the dry measuring cell.

Remove the upper cover plate and the upper measuring cell window.

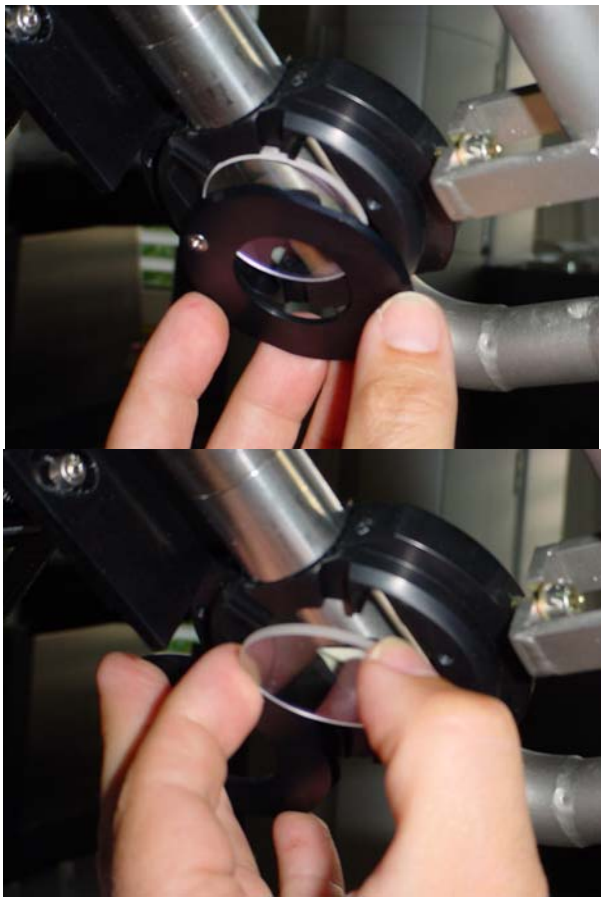
Then you can remove both ceramic end pieces that are inserted as parallel stops for the measuring cell windows.

Now clean the upper window. The cleaning process is the same as described for cleaning of the liquid measuring cell.
Now unscrew the front screw of the cover plate facing down.

Only loosen the rear screw. You can then turn the lower cover plate around this screw to be able to remove the lower glass.

Attention:

When turning the cover plate, make certain that the window does not fall out of the holder.



Now clean the lower window. The cleaning process is the same as described for cleaning of the liquid measuring cell.
There are no seals to be cleaned in the dry measuring cell. The seal is created by the metal-metal, glass-metal and glass-ceramic surfaces. Above all, make certain that no dust particles are located on the ceramic surfaces. All surfaces must be perfectly clean.

Dust particles on the surface cause the measuring cell to no longer function properly and the beam loses its calibration upon moving of the measuring cell.

5.2.3 Assembly of the Measuring Cell

Reassemble the measuring cell in reverse order.

5.3 Measuring with the „Dry Dispersing Unit“

After the measurement starts, the vacuum above its control cabinet is first switched on. Then the compressed air and finally the vibration dosing channel is switched on. To stop the measurement, repeat the steps in reverse order. The dosing channel does not operate during the background measurement.
The background measurement takes about 20 seconds because the measuring cycle is always cleaned first. Immediately after the "background measurement" and still before the actual measurement, the dosing channel is switched on and regulated such that the previously configured value for the beam absorption is maintained. After the measurement is completed, the data is then automatically loaded and the particle size distribution calculated.
The vibration dosing channel automatically sets the "dosing rate" as a vibration amplitude and the "quantity" as a distance between the funnel and the vibration channel. The quantity is set as low as possible and the dosing rate as high as possible. This ensures the supply of a thin sample layer to the nozzle and results in optimal conditions.

The dry dispersing unit is a fully automatic system.

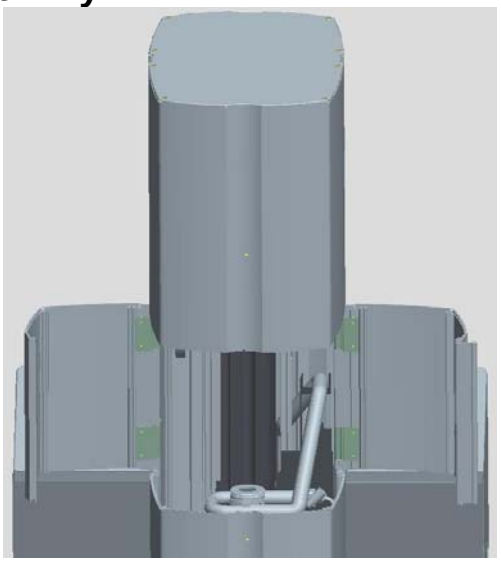
To apply initial settings to the dosing, select the functions "Setup", "NanoTec / MicroTec Control Window" to configure specific settings. These settings are overwritten during the measurement.

With an absorption setting of 2 to 5 per cent, the vibration dosing channel supplies as much sample material as possible to fulfill this requirement. First the quantity is increased, and after the value 6 is reached, the amplitude is also increased by steps of one. The settings for this measurement are saved in the results file and can be reloaded.

To add sample material, add your sample material into the funnel. After clicking on "Start Measurement", the measurement is performed.
The sample moves forward on the dosing channel. Because at the beginning no sample is conveyed into the laser, it may occur that the measuring device control quickly increases the transport rate. However, this is very quickly corrected when sample is first transported.
Observe the flow behavior of the sample. For samples that do not flow well, you should further configure the limits of the beam absorption. Samples that flow well can be measured, for example, with a minimum beam absorption of 2% and a maximum beam absorption of 3%. The more difficult the sample is, the more you should extend the limits, for instance, up to a maximum beam absorption of up to 6%.

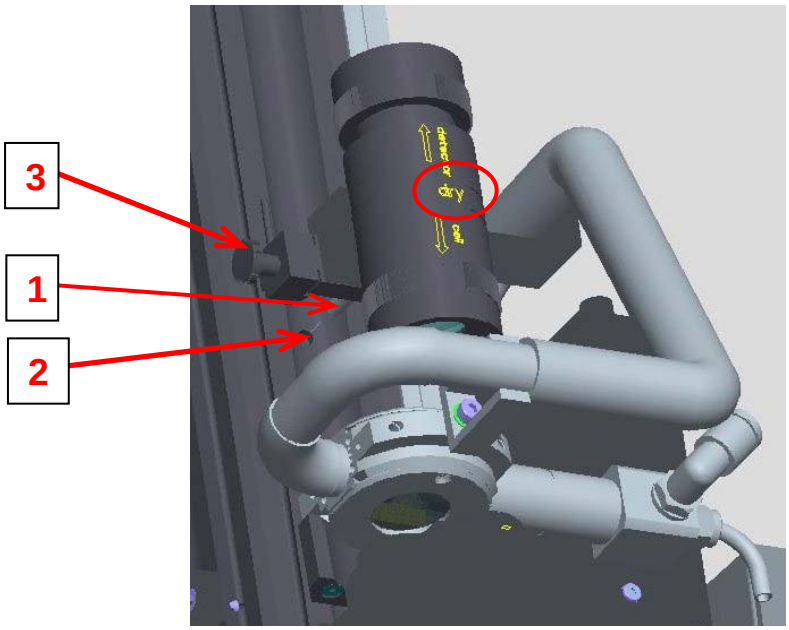
The fluctuations that you permit in this way directly affect the reproducibility of your measurement. If you would like to keep the limits low with a sample that does not flow well, you need significantly more sample!

5.4 Mounting instructions Measuring Range Extension Kit “Dry”

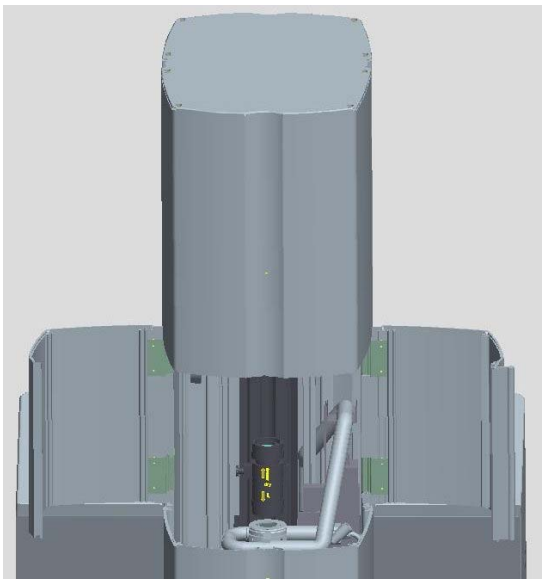


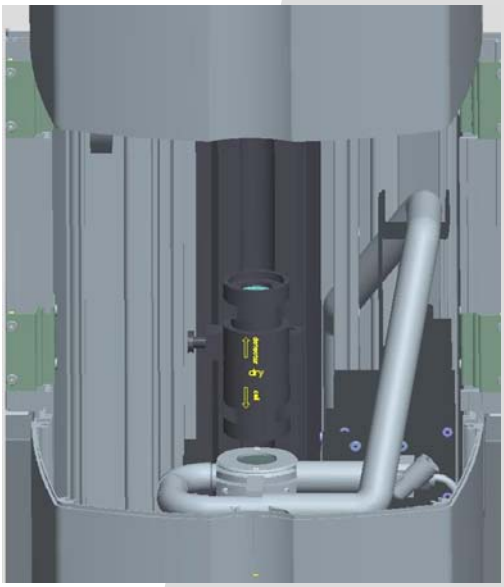
1. Configuration, Set Configuration, NanoTec/MicroTec System, Use Option for extended Measuring Range. Please note the software instructions.

2. Take the Measuring Extension Kit ***“dry”*** from the accessories case and remove lens caps.



3. Introduce the body of the tube with locating pin (1) into the drilling planned for it (2) in the profile of the optical bench. Insert the measuring range extension kit in such a way that the signature ***"cell"*** shows towards the measuring cell. Put the rider on the profile and tighten the knurled thumb screw (3).





4. Ready
5. For the disassembly of the measuring range extension kit proceed in reverse order.

6 Accessories

6.1 "analysette 22 WINDOWS" Program

With the software package "analysette 22 for WINDOWS", all functions of the COMPACT, COMFORT, ECONOMY NanoTec and MicroTec versions can be programmed and controlled (see user manual "analysette 22 for Windows").

6.2 Small Quantity Dispersing Unit

6.2.1 Connection of the small volume dispersing unit

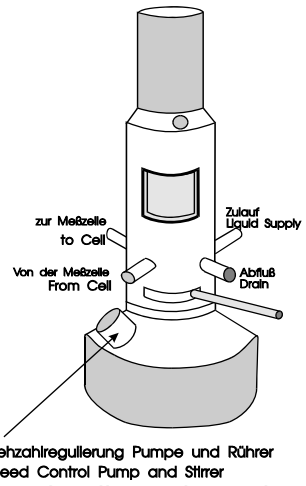
The small quantity dispersing unit is connected directly to the measuring cell in the measuring device. It has four hose connections labelled with:

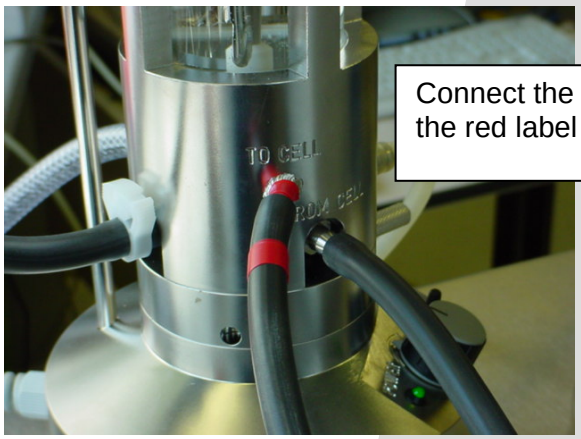
- "FROM CELL"
- "TO CELL"
- "IN"
- "OUT".

"FROM CELL" and
"TO CELL" must be connected with the measuring cell.

Kleinmengen-Dispergiereinheit

Small Dispersing Unit





Connect the tube with the red label → to cell

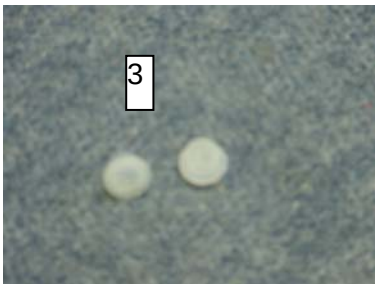
"IN" on the dispersing unit serves to fill the measuring apparatus and is connected either to a central supply line with, for instance, demineralised, filtered water, or to a storage tank with measuring fluid.
"OUT" serves to discharge the measuring and rinsing fluid;

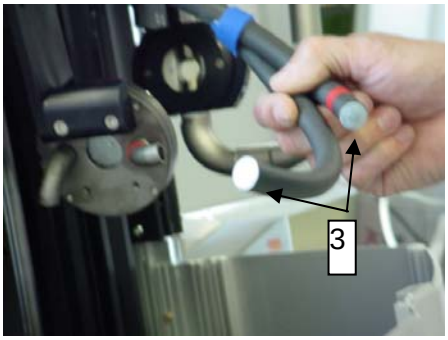
Attention:
The maximum water pressure in the device is 0.5 bar !

6.2.2 Small volume dispersing unit for manual change of the measuring cell "liquid"

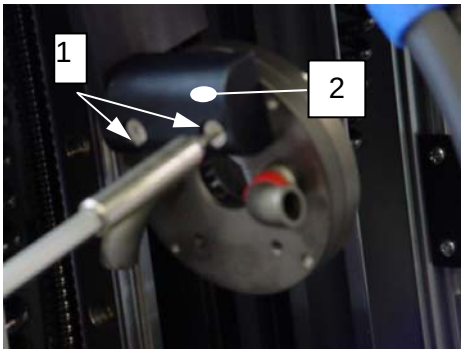
For the conversion to the small volume dispersing unit you need to perform the following steps:

1. Drain off the hole system (please see chapter 4.3.2.3 "Preparation")
2. Put the liquid measuring cell to the "park position" (please see chapter 4.3.2.5 "Cleaning")
3. Release the tubes from the liquid measuring cell and press the delivered plastic stoppers (3) on the tube openings.

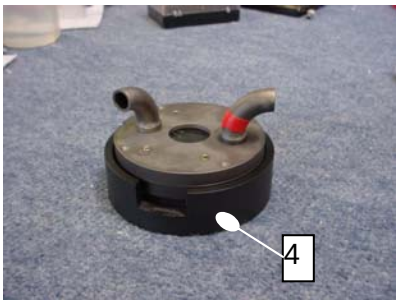




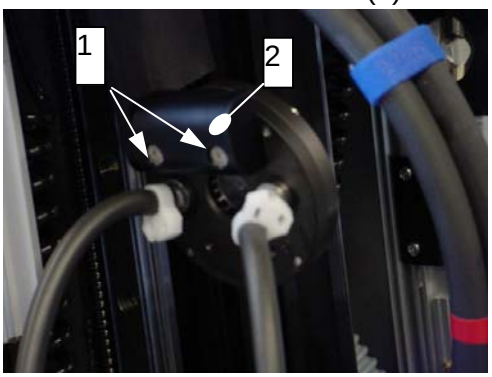
4. Release the screws (1) at the holding device (2) with the delivered tools.



5. Put the liquid measuring cell on the measuring cell holder (4). The tubes stay in the instrument.



6. Then put the small volume dispersing unit on the hood space on the right hand side of the tower housing.
1.
7. Put the tubes with the measuring cell behind the tower housing on the left hand side of the instrument, where the holes for the plug-in of the measuring cell tubes are located.
8. Now take the measuring cell of the small volume dispersing unit and fix it with the screws (1) to the holding device (2)



9. Then plug the tubes which lead to the measuring cell of the small dispersing unit through the holes which are located at the side of the housing.

Please pay attention to the position control clips.

10. The connection of the small volume dispersing unit is effected as described in chapter 6.2.1. "Connection of the small volume dispersing unit"

7 Maintenance

The analysette 22 NanoTec and MicroTec requires no maintenance apart from the regular cleaning.

Before starting the work in the device, switch off the measuring device and unplug the power cord!

8 Warranty

The warranty card enclosed with the device upon delivery must be completely filled out and returned to the delivering factory so that the warranty can enter into effect. The company FRITSCH GmbH Laborgerätebau, Idar-Oberstein and its "Technical Application Laboratory" or the corresponding national representatives will be glad to offer advice and assistence.
Indication of the serial number imprinted on the type plate is required with any questions.

9 Troubleshooting

9.1 Error List

Error	Possible Cause	Remedy
Lamp	Power connection missing	Plug in the power plug
Does not light	Main switch	Switch on the main switch
	Mains fuse	Replace the mains fuse

9.2 Transferability of Measurement Results

If a measurement of particles is intended to determine which of their assumed properties are true, the measurer is not only an observer and the measuring device is not only his tool; rather, both participate actively in the process. In the determination of particle size distributions, both are active in generating the result and determining its nature.
In the development of measuring devices, the designer strives to eliminate the influence of the operator as much as possible. However, the effects of the physical measurement process applied and its realisation in the device cannot be ignored.
If, for instance, particle size distributions are determined according to the sedimentation process (scanning photo sediment graph "analysette 20") and through the evaluation of a diffraction image, results that differ slightly from each other must be expected at the least.
In the measurement of particle sizes through the analysis of a diffraction image, all dimensions of irregular particles are "seen" and correspondingly taken into account in the result. For instance, the longitudinal extent of needle-shaped samples are also determined here. In a comparison or the transfer of particle size distributions from various measuring processes, the particle shape must be taken into consideration.

9.3 Selection of Liquids for Suspensions

Because the measuring fluid in the entire device can come into contact with materials that are not chemically resistant, certain organic liquids or saturated inorganic salt solutions cannot be selected. (The measuring fluid comes into contact with stainless steel, glass, Teflon, Viton (FPM and FKM) and PA66 (Nylon). The standard connection hoses are made of Viton.)

Only water is approved by Fritsch as a suspension liquid for the dispersing unit.

Before the planned use of other measuring fluids, the factory must first be consulted. For measuring samples incompatible with water, a liquid can be selected from the following list:

In principle, the use of explosive or flammable liquids is forbidden - they may not be used.

The following summary serves only to indicate the chemical compatibility of the device in relation to liquids.

Mono-, di- or trihydric alcohols (except for methanol, ethyl alcohol, isopopyl alcohol, gylcol or glycerine),
Mineral and organic oils such (petroleum and soy oil, nut oil, olive oil)
Before the planned use of other measuring fluids, the factory must first be consulted.

The following may not be used:

Ketones (acetone, propanone, butanone, cyclohexanone),
Ether, fluorochlorohydrocarbons,
Amines, freon 21-32,
Methanol, aniline, benzine
Chlorohydrocarbons
Ethanoic acid and its derivatives,
Undiluted acids and bases.
Even samples present in oil (e.g. oils similar to machine oil) do not also have to be measured in oil.

Example: Toner in machine oil

The sample is first dispersed in ethylene glycol with a drop of tenside (Pril) in the ultra-sound bath. Then a mixture is created 1:1 with water and this is added to the ultra-sound bath of the laser particle sizer "analysette 22".

Example: Raw cocoa mixture

Raw cocoa mixture is typically measured in acetone or benzine (known from the sieving process). Measurement in the "analysette 22" can also be performed in peanut oil, for instance. Because peanut oil is suitable for use with food, the waste oil can also be used as a lubricant on the rollers, solving the disposal problem.

Example: Weakly magnetic materials

In general, particle size distributions of magnetic substances cannot be measured in suspensions due to the mutual attraction of the individual particles. However, due to the high sensitivity of the "analysette 22", very low concentrations - in other words relatively large distances between the individual particles - can be used on one hand, and on the other, substances can also be suspended with high viscosity liquids due to the high power of the centrifugal pump.
If larger particles or particles with higher density must be measured, the share of glycerine can be increased up to a ratio of 7:3. In general, liquids up to a viscosity of 30 cPoise can still be pumped without problems by the pump system of the dispersing unit.

9.4 Dispersing of Poorly Wettable Samples

Hydrophobic samples can be dispersed despite their water-repulsing properties if they are first mixed into a paste with a fluid tenside (Pril) and then dispersed in water under constant stirring.
Agglomerates are also dispersed more easily and more quickly in an ultra-sound bath because the entire sample is subjected to the ultra-sound. In the circuit of the dispersing unit, only the quantity in the bath is in the area of the ultra-sound.
For soil samples, 0.1 - 0.5% sodium pyrophosphate solution is recommended as a dispersing aid, for example. The sample prepared in this way in an ultra-sound bath (e.g. "laborette 17" can be measured in pure water.

9.5 Measurement of Weakly Soluble Samples

Even samples that are weakly soluble in liquid can be measured with the laser particle sizer "analysette 22". To do this, preparation of a saturated measuring liquid is recommended. In this liquid, the particle size cannot change by dissolving - the measurement results therefore remain inaccurate. (However, the saturated solution must be filtered before use.)
For very expensive products, it is sometimes worthwhile to identify a replacement substance that takes over the task of "saturating" the measuring liquid.